①

$$\vec{M} = \vec{r} \times \vec{F}$$

$$M = rF \operatorname{sen}\theta$$

$$M = Fd \operatorname{sen}\theta = Fd \frac{b}{\sqrt{(d+a)^2+b^2}}$$

$$\sqrt{(d+a)^2+b^2} = d \frac{Fb}{M} \to k$$

$$[(d+a)^2+b^2] = d^2 k^2$$

$$[d^2 + 2ad + a^2 + b^2] = d^2 k^2$$

$$d^2k^2 - d^2 - 2ad - a^2 - b^2$$

$$d^2(k^2-1) + d(-2a) + (-a^2-b^2) = 0$$

$$\downarrow a' \quad \downarrow b' \quad \downarrow c'$$

$a' = k^2-1$ →	4.0625	4.29	4.41	4.44
$b' = -2a$ →	-0.6	-0.8	-1	-1.2
$c' = -a^2-b^2$ →	-0.9	-1.16	-1.46	-1.8
d_1 (m)	0.55	0.622	0.699	0.786
d_2 (m)	-0.40	-0.435	-0.473	-0.516

	Tema1	Tema2	Tema3	Tema4
M (N·m)	960	1000	1040	1080
F (N)	2400	2300	2200	2100
b (m)	0.9	1	1.1	1.2
a (m)	0.3	0.4	0.5	0.6

② La solución para los otros temas se adjunta en archivo xls

$\varnothing_P = 175$ mm

$F_1 = 150$ N ∡ 20°

$F_2 = 230$ N ↓

$F_3 = 165$ N ∡ 10°

$F_4 = 320$ N ∡ 10°

①

$\vec{r}_1 = (-405\hat{i} + 29.93\hat{j} + 82.22\hat{k})$ mm

$\vec{F}_1 = (0\hat{i} - 140.95\hat{j} + 51.30\hat{k})$ mm

$\vec{M}_1 = (13125\hat{i} + 20777.72\hat{j} + 57086.33\hat{k})$ N·mm

②

$\vec{r}_2 = (-405\hat{i} + 0\hat{j} - 87.5\hat{k})$ mm

$\vec{F}_2 = (0\hat{i} - 215\hat{j} + 0\hat{k})$ N

$\vec{M}_2 = (-18812.5\hat{i} + 0\hat{j} + 87075\hat{k})$ N·mm

③

$\vec{r}_3 = (-180\hat{i} + 86.17\hat{j} - 15.19\hat{k})$ mm

$F_3 = (0\hat{i} - 28.65\hat{j} - 162.49\hat{k})$ N

$M_3 = (-14437.5\hat{i} + 29248.79\hat{j} + 5157.35\hat{k})$ N·mm

④

$\vec{r}_4 = (-180\hat{i} - 86.17\hat{j} + 15.19\hat{k})$ mm

$\vec{F}_4 = (0\hat{i} - 45.14\hat{j} - 256.05\hat{k})$ N

$\vec{M}_4 = (22750\hat{i} - 46089\hat{j} + 8126.73\hat{k})$ N.mm

$\vec{F}_R = (0\hat{i} - 429.75\hat{j} - 367.24\hat{k})$ N

$\vec{M}_R = (2625\hat{i} - 54560.07\hat{j} + 157445.41\hat{k})$ N.mm

$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4 \qquad \vec{M}_R = \vec{M}_1 + \vec{M}_2 + \vec{M}_3 + \vec{M}_4$

3 - Tema 1

$\theta_1 = \tan^{-1}\frac{80\text{mm}}{100\text{mm}} = 38.66°$

$\theta_2 = \tan^{-1}\frac{80\text{mm}}{200\text{mm}} = 21.8°$

D: Apoyo en rodillo o patín

$$\circlearrowleft \Sigma M_C = 600\text{N} \cdot 200\text{mm} - F_{BE} \operatorname{sen}\theta_2 \times 100\text{mm} = 0$$

$$F_{BE} = \frac{600\text{N} \cdot 200\text{mm}}{\operatorname{sen} 21.8° \times 100\text{mm}} = 3231.298\text{ N}$$

$$\circlearrowleft \Sigma M_B = 600\text{N} \cdot 100\text{mm} - F_{CF} \operatorname{sen}\theta_1 \cdot 100\text{mm} = 0$$

$$F_{CF} = \frac{600\text{N} \cdot 100\text{mm}}{\operatorname{sen} 38.66° \cdot 100\text{mm}} = 960.465\text{N}$$

$$\xrightarrow{+} \Sigma F_x = F_{CF}\cos\theta_1 + F_{BE}\cos\theta_2 - D_x = 0$$

$$D_x = 960.465\text{N}\cos 38.66° + 3231.298\text{N}\cos 21.80°$$

$$D_x = 3748.531\text{ N}$$